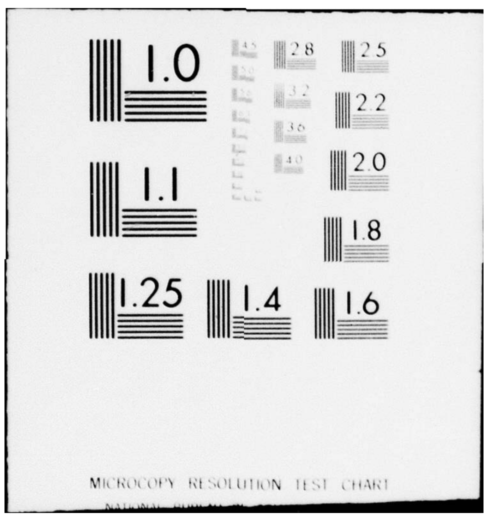
AD-A061 635 SACLANT ASW RESEARCH CENTRE LA SPEZIA (ITALY) F/G 15/5
OCEANOGRAPHIC CONDITIONS IN THE COASTAL WATERS OF N. W. ITALY D--ETC(U)
OCT 78 A J ELLIOTT, F DE STROBEL

UNCLASSIFIED SACLANTCEN-SM-116 NL

1 OF 1
AD
A061 635

END
DATE
FILMED
2-79
DDC


1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6
MICROCOPY RESOLUTION TEST CHART

SACLANTCEN Memorandum SM - 116

AD A061 635

(12)

SACLANTCEN Memorandum
SM - 116

LEVEL II

SACLANT ASW RESEARCH CENTRE MEMORANDUM

OCEANOGRAPHIC CONDITIONS IN THE COASTAL WATERS OF N.W. ITALY DURING THE SPRING OF 1977

by

ALAN J. ELLIOTT and FEDERICO DE STROBEL

DDC
RECEIVED
NOV 17 1978
F

1 OCTOBER 1978

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

DDC FILE COPY

NORTH
ATLANTIC
TREATY
ORGANIZATION

LA SPEZIA, ITALY

This document is unclassified. The information it contains is published subject to the conditions of the legend printed on the inside cover. Short quotations from it may be made in other publications if credit is given to the author(s). Except for working copies for research purposes or for use in official NATO publications, reproduction requires the authorization of the Director of SACLANTCEN.

78 11 16 202

This document is released to a NATO Government at the direction of the SACLANTCEN subject to the following conditions:

1. The recipient NATO Government agrees to use its best endeavours to ensure that the information herein disclosed, whether or not it bears a security classification, is not dealt with in any manner (a) contrary to the intent of the provisions of the Charter of the Centre, or (b) prejudicial to the rights of the owner thereof to obtain patent, copyright, or other like statutory protection therefor.

2. If the technical information was originally released to the Centre by a NATO Government subject to restrictions clearly marked on this document the recipient NATO Government agrees to use its best endeavours to abide by the terms of the restrictions so imposed by the releasing Government.

Published by

STI

SACLANTCEN

INITIAL DISTRIBUTION

MINISTRIES OF DEFENCE

	Copies
MOD Belgium	2
DND Canada	10
CHOD Denmark	8
MOD France	8
MOD Germany	15
MOD Greece	11
MOD Italy	10
MOD Netherlands	12
CHOD Norway	10
MOD Portugal	5
MOD Turkey	5
MOD U.K.	16
SECDEF U.S.	61

NATO AUTHORITIES

Defence Planning Committee	3
NAMILCOM	2
SACLANT	10
SACLANTREPEUR	1
CINCWESTLANT/COMOCEANLANT	1
COMIBERLANT	1
CINCEASTLANT	1
COMSUBACLANT	1
COMMAIREASTLANT	1
SACEUR	2
CINCNORTH	1
CINCSOUTH	1
COMNAVSOUTH	1
COMSTRIKFORSOUTH	1
COMEDCENT	1
COMMARAIRMED	1
CINCHAN	1

SCNR FOR SACLANTCEN

	Copies
SCNR Belgium	1
SCNR Canada	1
SCNR Denmark	1
SCNR Germany	1
SCNR Greece	1
SCNR Italy	1
SCNR Netherlands	1
SCNR Norway	1
SCNR Portugal	1
SCNR Turkey	1
SCNR U.K.	1
SCNR U.S.	2
SECGEN Rep.	1
NAMILCOM Rep.	1

NATIONAL LIAISON OFFICERS

NLO Canada	1
NLO Denmark	1
NLO Germany	1
NLO Italy	1
NLO U.K.	1
NLO U.S.	1

NLR TO SACLANT

NLR Belgium	1
NLR Canada	1
NLR Germany	1
NLR Greece	1
NLR Italy	1
NLR Norway	1
NLR Portugal	1
NLR Turkey	1

Total initial distribution	232
SACLANTCEN Library	10
Stock	38
Total number of copies	280

14 SACLANTCEN ~~MEMORANDUM~~-SM-116

NORTH ATLANTIC TREATY ORGANIZATION

SACLANT ASW Research Centre
Viale San Bartolomeo 400, I-19026 San Bartolomeo (SP), Italy
Tel: (0187)503540
Telex: 28148

9 Memorandum rept.,

6 OCEANOGRAPHIC CONDITIONS IN THE COASTAL WATERS
OF N.W. ITALY DURING THE SPRING OF 1977.

by

10 Alan J. Elliott ~~and~~ Federico De Strobel

11 1 Oct~~ober 19~~78

12 27p

This memorandum has been prepared within the SACLANTCEN Underwater Research Division.

G.C. VETTORI
Division Chief

312 950

TABLE OF CONTENTS

List of Figures

ACCESSION for
NTIS White Section
DDC Buff Section
UNANNOUNCED
JUSTIFICATION
BY
DISTRIBUTION/AVAILABILITY CODES
Dist. AVAIL. and/or SPECIAL
A

78 11 16 202

OCEANOGRAPHIC CONDITIONS IN THE COASTAL WATERS OF N.W. ITALY DURING THE SPRING OF 1977

by

Alan J. Elliott and Federico De Strobel

ABSTRACT

Two month long current and meteorological records, collected during the spring of 1977, have been used to determine the mean currents along the northwestern coast of Italy and to estimate the correlation between the variations in the flow and the large-scale winds. The overall flow was found to be northwestwards along the coast, with a speed of about 4 cm/s. This flow was directed against the mean alongshore wind and for zero wind conditions the mean flow along the coast was predicted to have a speed of 5 cm/s. This gives direct evidence of an alongshore density-driven current in the Tyrrhenian Sea. The data suggested that a significant proportion of this flow continued northwards past Elba into the Ligurian Sea. The coherence between the current and the wind fluctuations was low; on average only about 20% of the current fluctuations could be attributed to the wind. It is probable that both the local bottom topography and the dynamics of the deep basins will have influenced the response of the coastal currents. There was a uniform warming of the coastal waters during April and May, the mixed-layer temperature increasing from about 14°C to 18°C. Near-bottom temperatures remained constant and the warming was confined to the upper layers of the water column, suggesting that advective effects were not important. This was supported by the low horizontal gradients and the absence of a warm water mass to the south. The increase in temperature was reflected in the sound-speed characteristics of the area, the mean sound speed in the mixed-layer increasing from 1509 m/s during late March to 1522 m/s at the end of May. The water column, which had been vertically well-mixed at the beginning of the observations, stratified considerably during the spring and by the end of May there were significant vertical temperature gradients at depths of 15 m and 50 m.

INTRODUCTION

During April and May of 1977 current measurements were made at two locations off the northwestern coast of Italy in water approximately 100 m deep and 15 km offshore. The two moorings, which were 100 km apart, were located on opposite sides of the shallow water that extends between the Italian mainland and the island of Corsica (Fig. 1). A third mooring, placed 100 km further to the south near Civitavecchia, was lost during the experiment and no data are available from it. Three oceanographic cruises were made at approximately monthly intervals to survey the temperature/salinity properties of the coastal waters near the mooring positions, and meteorological and sea level data were obtained from established coastal recording stations. The purpose of the study was to gain an understanding into those mechanisms that may contribute to the variability in coastal waters, and to obtain estimates of the time scales involved. Ultimately, it is hoped that this will lead to a better understanding of the variability of sound-speed characteristics in the coastal zone and that this, in turn, will allow better prediction of the acoustic propagation through shallow coastal waters. We can find no reference to prior investigations into the coastal dynamics of this region at the storm time scale (2-20 days), and the present *in-situ* current measurements are among the first to be reported in the open literature for this portion of the Italian coast. Previous studies into the circulation of the Ligurian and Tyrrhenian Seas have relied on indirect methods such as isentropic analysis to track the spreading of water masses (e.g. *[1]*), or the geostrophic method (e.g. *[2]*). The mean circulation is thought to be a cyclonic gyre of surface water that enters the southern Tyrrhenian Sea from the west through the channel south of Sardinia. Part of this flow passes eastwards through the Strait of Sicily while the remainder moves along the northern coast of Sicily, flows up the western coast of Italy, and then turns southwards near Elba and completes the gyre by moving down the east coast of Sardinia. A portion of the flow is thought to continue northwards past Elba and into the Ligurian Sea. Between the depths of 200 m and 500 m there is a layer of intermediate water of relatively high temperature and salinity. This water originates in the Levantine Basin of the eastern Mediterranean and enters the western basin through the Strait of Sicily beneath the eastward-flowing surface layer. This deeper water also flows cyclonically around the Tyrrhenian Sea before progressing into the main portion of the western basin. A brief review of the circulation has been given by Sankey *[3]*.

For our investigation, two current moorings were placed in water 100 m deep and 15 km offshore. Each sub-surface mooring supported two current meters: one at a depth of 20 m and the other at 80 m. The data series were filtered with a lowpass filter to remove the tidal and other high-frequency components; the particular filter used spanned 100 hours of data and had a response close to unity for time scales longer than 2 days and near zero for time scales shorter than 25 hours. The data were then resampled at 6-hour intervals after filtering; in this manner

FIG. 1 THE LIGURIAN AND TYRRHENIAN SEAS, showing the locations of the current moorings and the wind and sea-level stations.

each original record, of length about 60 days, was reduced to a sequence of about 200 values. A similar filtering was applied to the components of the wind stress and to the sea-level data.

The present analysis is concerned with a presentation of the data, and with an investigation into the correlation between the alongshore and on/offshore currents and the coastal winds; a separate paper will discuss the time scales and the frequency dependence of the response.

1 THE HYDROGRAPHY

Figure 2 shows the surface distributions for temperature, salinity, and sound speed at approximately monthly intervals from late March to the end of May, 1977. There were no significant horizontal gradients in any of the parameters and, consequently, the values have not been contoured (the contours shown are the 100 m and 200 m isobaths). The most apparent feature was the surface warming, near-surface temperature increasing from 14.6°C in March to 15.5°C by the end of April and then to 18.5°C by late May. There was no apparent spatial pattern to the temperature distribution; since the data were collected during two-day cruises some of the variability may have been due to the diurnal heating cycle. This view was supported by a satellite image of the Tyrrhenian Sea taken on April 23, which showed insignificant horizontal temperature gradients. Therefore, there appeared to have been a uniform heating of the coastal waters, due to seasonal changes, throughout the period of the study. This is supported by Fig. 3, which shows the values of air temperature recorded at Ponza. The mid-day air temperature increased by about 10°C during the months of April and May, and this was apparently sufficient to warm the surface coastal water by 4°C. (The increase in the water temperature must have been due to local heating since the satellite image did not show a region of warm water to the south that could have been advected into the study zone.) The increase in surface temperature was reflected in the sound speed data, which showed an increase from 1509 m/s during March to around 1522 m/s during May. The largest horizontal gradients of sound speed within the mixed-layer occurred during May and amounted to changes of about 5 m/s over distances of 50 km; however, as noted previously, this variability may have been due in part to the effects of diurnal heating. The changes in salinity were not significant, the mean salinity being of the order of 37.7‰.

The vertical structure of the temperature, salinity, and sound speed are shown in Fig. 4 for a location near the southern mooring position (near the island of Formiche di Grosseto). The most apparent feature was the increase in temperature of the surface layers and the corresponding increase in sound speed during the two-month period. The water column changed from being nearly well-mixed during late March to a stratified column in May. The stratification was strongest near a depth of 15 m and there was the suggestion of a second gradient region near 50 m above the colder bottom water. The uniformity in the temperature (and sound speed) of the deep water is a good confirmation of the accuracy and calibration of the STD system, and is further evidence that the increase

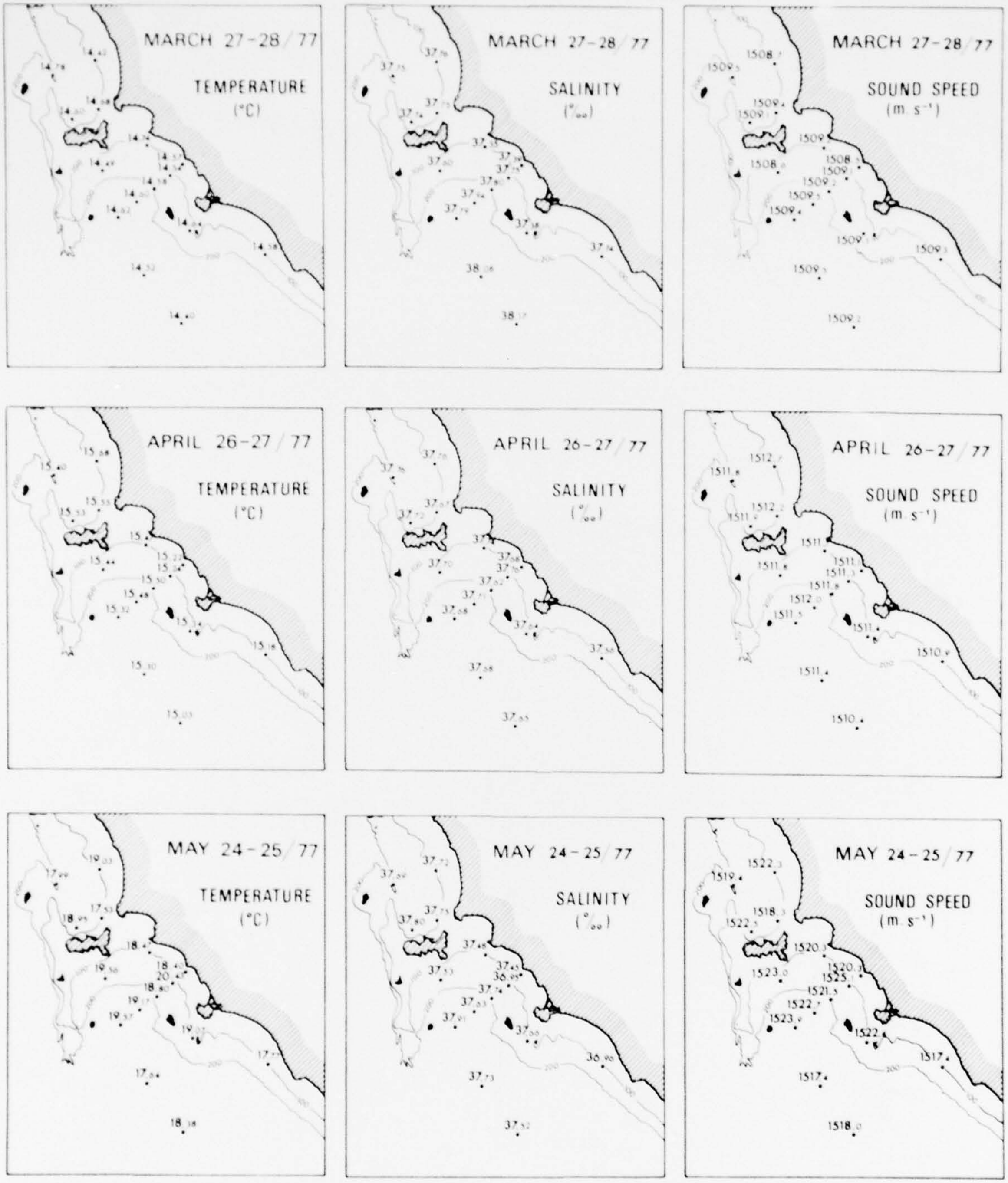


FIG. 2 THE MIXED-LAYER VALUES OF TEMPERATURE, SALINITY, AND SOUND SPEED measured during March 27-28, April 26-27 and May 24-25, 1977.

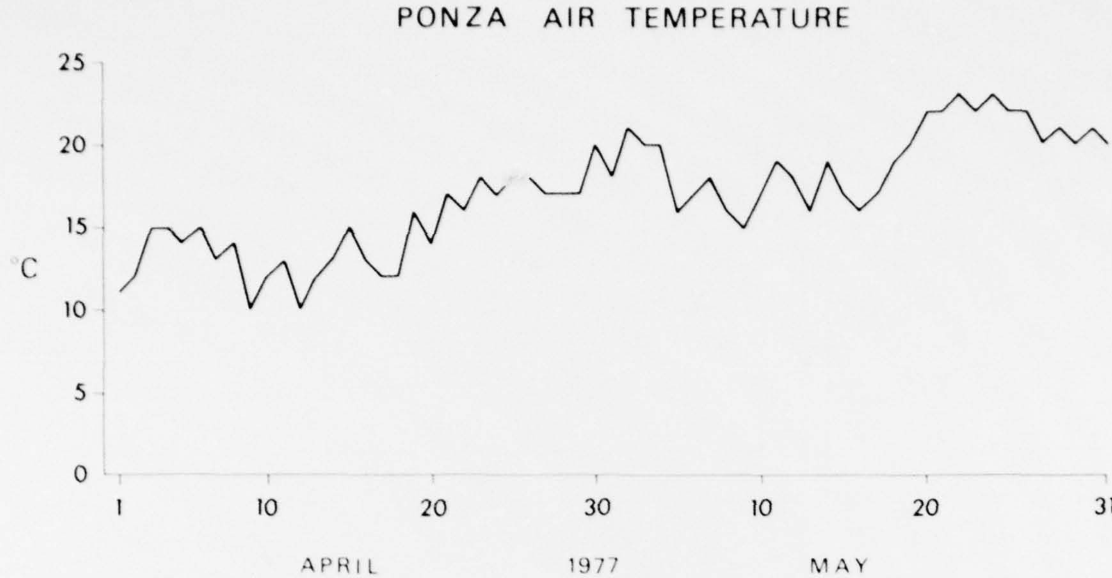


FIG. 3 MID-DAY AIR TEMPERATURE RECORDED AT PONZA during April and May, 1977.

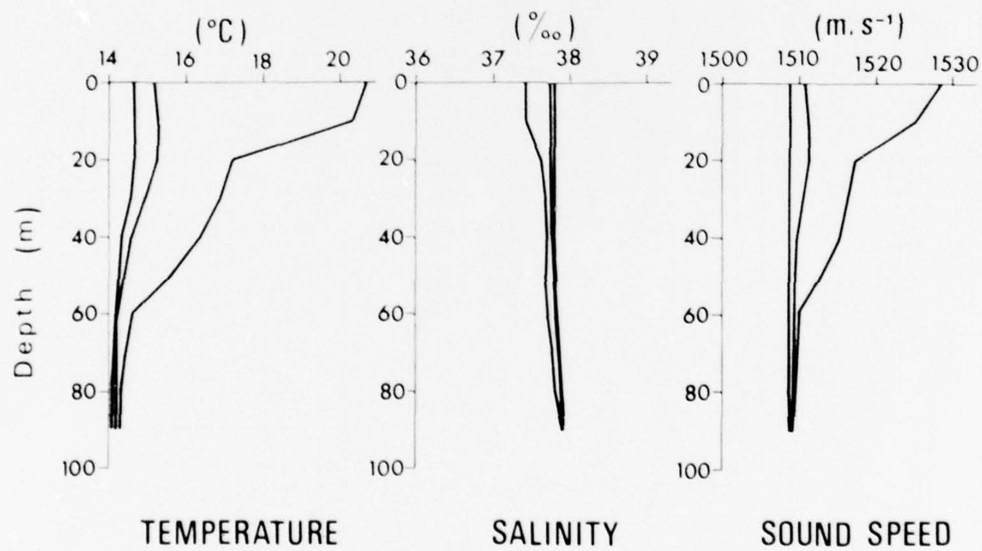


FIG. 4 VERTICAL PROFILES OF TEMPERATURE, SALINITY, AND SOUND SPEED measured near the southern mooring during March, April, and May.

in temperature of the coastal water was due to surface heating. Figure 5 shows the vertical profiles of sigma-t at the two mooring locations. The increase in temperature caused a reduction in the density of the surface water and at both locations the water column changed from being almost neutrally stable during March to a two-layered system, with a surface mixed-layer about 10 m deep, during May. It is important to note that, at both mooring locations, the current meters were moored beneath the depth of the surface mixed-layer.

2 DISTRIBUTION OF THE COASTAL WINDS

Wind data were obtained for the five positions shown in Fig. 1 (Genova, Pisa, Civitavecchia, Olbia, and Ponza) and the stress vector was computed for each location by using the relationship *[4]*

$$\underline{\tau} = 1.56\ 10^{-2}\ \underline{W}|\underline{W}|$$

where $\underline{\tau}$ is the stress vector in dyn/cm^2 and $\underline{W}$ was the observed wind vector in m/s. The time series of the stress distributions were then lowpass filtered and the data resampled at 6-hourly intervals.

There was significant spatial variability in both the strength and the direction of the lowpass coastal winds. Whereas the mean stress at the three sourthern stations (Civitavecchia, Olbia, and Ponza) was directed eastwards with a strength of about 0.5 dyn/cm^2, the mean stress at Genova and Pisa was about an order of magnitude weaker; at Pisa the mean stress vector was directed towards the N.E. while at Genova it was towards the N.W.

This anticlockwise rotation of the mean wind may have been generated by cyclogenesis *[5]*, or it may have been caused by orographic effects. *Empirical orthogonal function (EOF) analysis* is a technique that can be used to partition simultaneous time series into groups having similar characteristics. For example, Kundu et al *[6]* used the method to determine the vertical modal structure of coastal currents, while one of the present authors *[7]* isolated a baroclinic response within an estuarine system by showing that the near-bottom current and the wind stress were related through a computed orthogonal function. The same technique was applied to the five components of E-W wind stress, using as input the correlation matrix shown in Table 1 (a summary of the method can be found in *[8]*). Of the five modes isolated (since there were five input series) the first mode was highly correlated with the components of stress at Pisa, Civitavecchia, Olbia, and Ponza but explained only 1% of the variance in the Genova record. In contrast, the second mode accounted for 95% of the Genova variance but was uncorrelated with the other locations. A similar result was obtained when the analysis was repeated for the N-S components of stress.

As a result of this partition of the wind records it was decided that the Genova wind was not representative and that the record had been

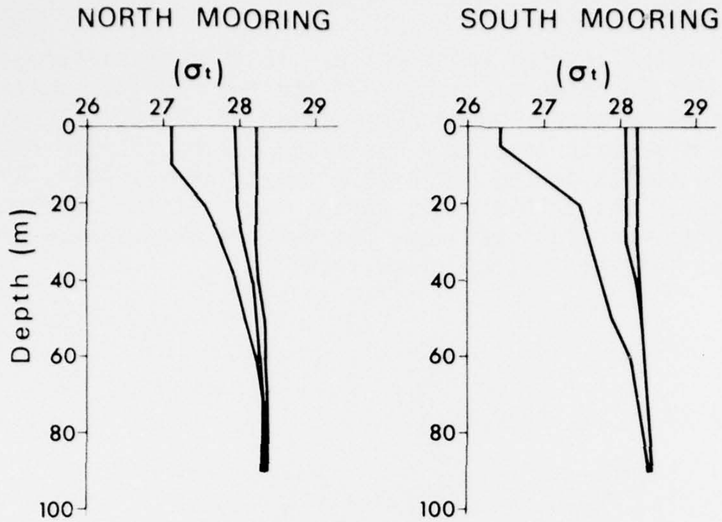


FIG. 5 VERTICAL PROFILES OF σt measured at the two mooring locations during March, April, and May.

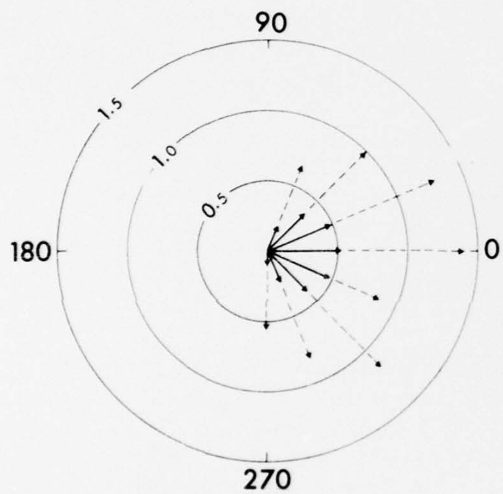


FIG. 6 DIRECTIONAL STATISTICS OF THE LARGE-SCALE MEAN WIND STRESS. The solid arrows represent the mean components and the dashed arrows show the standard deviations; units are dynes/cm^2.

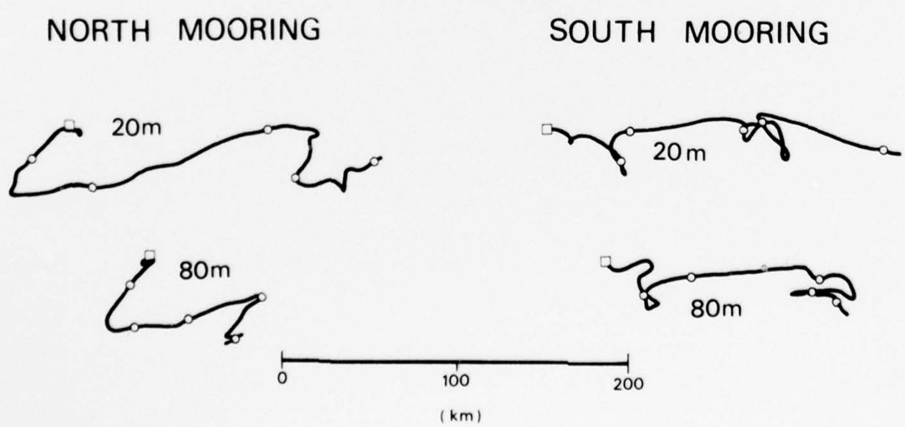


FIG. 7 PROGRESSIVE VECTOR DIAGRAMS OF THE LOWPASS CURRENTS. Each diagram has been rotated so that the local coastlines run from left to right across the page parallel to the distance scale. The circles are at 10-day intervals; the start positions are denoted by squares.

TABLE 1

CORRELATION MATRIX BETWEEN THE LOWPASS COMPONENTS OF E-W WIND STRESS

	GEN	PSA	OLB	CIV	PON
GEN	1.00	0.02	-0.13	0.11	0.14
PSA		1.00	0.54	0.56	0.62
OLB			1.00	0.57	0.64
CIV				1.00	0.82
PON					1.00

unduly influenced by orographic effects; it was therefore excluded from further analysis. The remaining four vector series were then averaged to produce a time series of the 'large-scale wind'. In addition, atmospheric pressure data were used to compute the geostrophic wind but this was found to have a low correlation with the observed winds. Consequently, the averaged large-scale wind was used in the further analysis.

Figure 6 presents the statistics of the large-scale wind stress after it had been resolved along the eight principal compass bearings; for each of the directions the solid arrow represents the mean stress while the dashed arrow shows the standard deviation. Overall, the mean wind stress was towards the east and the wind fluctuations were greatest in the E-W direction. There were also significant fluctuations in the NW-SE (alongshore) direction, and in the NE-SW (on/offshore) direction. It should be noted that in the alongshore direction the mean wind stress was directed towards the SE.

3 THE COASTAL CURRENTS AND THEIR RELATION TO WIND FORCING

This section is mainly concerned with a regression analysis between the coastal winds and the lowpass currents. Figure 7 shows progressive vector diagrams of the currents at the two mooring locations. Each of the diagrams has been rotated so that the local coastline is parallel to the distance scale, i.e. the local coastline has been aligned to run from left to right across the figure. As a consequence the net flow can be seen to be parallel to the local coastline and directed up the coast at each location. Visually, there appears to have been reasonable vertical correlation at the northern mooring, while the flow was less correlated in the south. The mean flow was of the order of 4 cm/s towards the NW; while at both locations there was a slight onshore drift

of the order of 0.5 cm/s at both 20 m and 80 m, the drift being more pronounced at the north mooring. (Possible sources of the onshore component of the velocity include: errors in the compass calibrations, which could rectify a portion of the alongshore flow into the on/offshore direction; a local curvature of the bottom topography, which would induce secondary circulations; or the onshore flow may have been part of a real wind-driven baroclinic flow structure, which we cannot resolve with data at only two depths.) The lowpass time series of the wind stress and currents, during the two-month period of April and May, are shown in Fig. 8.

Correlations between the current records, and between the currents and the wind, are given in Fig. 9. (For 200 data pairs the 95% significance level for the correlation coefficient is 0.14.) The vertical coherence was higher at the north mooring, the alongshore flow having a correlation of 0.78 between 20 m and 80 m depth. In general, the correlation was lower at the south mooring and the horizontal correlation was higher at 80 m than near the surface. The correlations between the alongshore wind and currents were of the order of 0.4 to 0.5, i.e. only 20 to 25% of the current variance in the alongshore direction could be attributed to the wind forcing. The offshore components had lower coherence and at the southern mooring the correlation between the offshore wind and flow was not significant.

Figure 10 shows the correlation with the wind as a function of wind direction. At the north mooring the alongshore current had its highest correlation with the wind that blew towards 157°, while at the southern mooring the correlation was highest with the wind towards 120°: these directions are both approximately parallel to the local coastlines, i.e. the alongshore response was greatest when the wind blew parallel to the shore. The offshore response was less clear: at the northern mooring the on/offshore flow was most coherent with the wind towards 110° — this is close to the alongshore direction of 130° (the on/offshore direction was around 40°). At the southern mooring there was no significant correlation between the on/offshore components of wind and current. The sea levels at both Genova and Livorno increased when the wind blew towards 90°. If the current and sea-level changes were due to free travelling disturbances (i.e. barotropic shelf waves) then the sea level and current fluctuations should be positively correlated due to a cross-shelf geostrophic balance *[6]*. However, with the present data there was no significant correlation between the alongshore currents and sea level. Consequently the correlation between sea level and the wind is more likely to have been due to a set-up caused by the on/offshore wind.

DISCUSSION

The main results of this study have been the determination of the mean flow and the finding of a generally poor correlation between the wind and the currents. On average only about 20 to 25% of the alongshore current variance could be related to the wind fluctuations, and

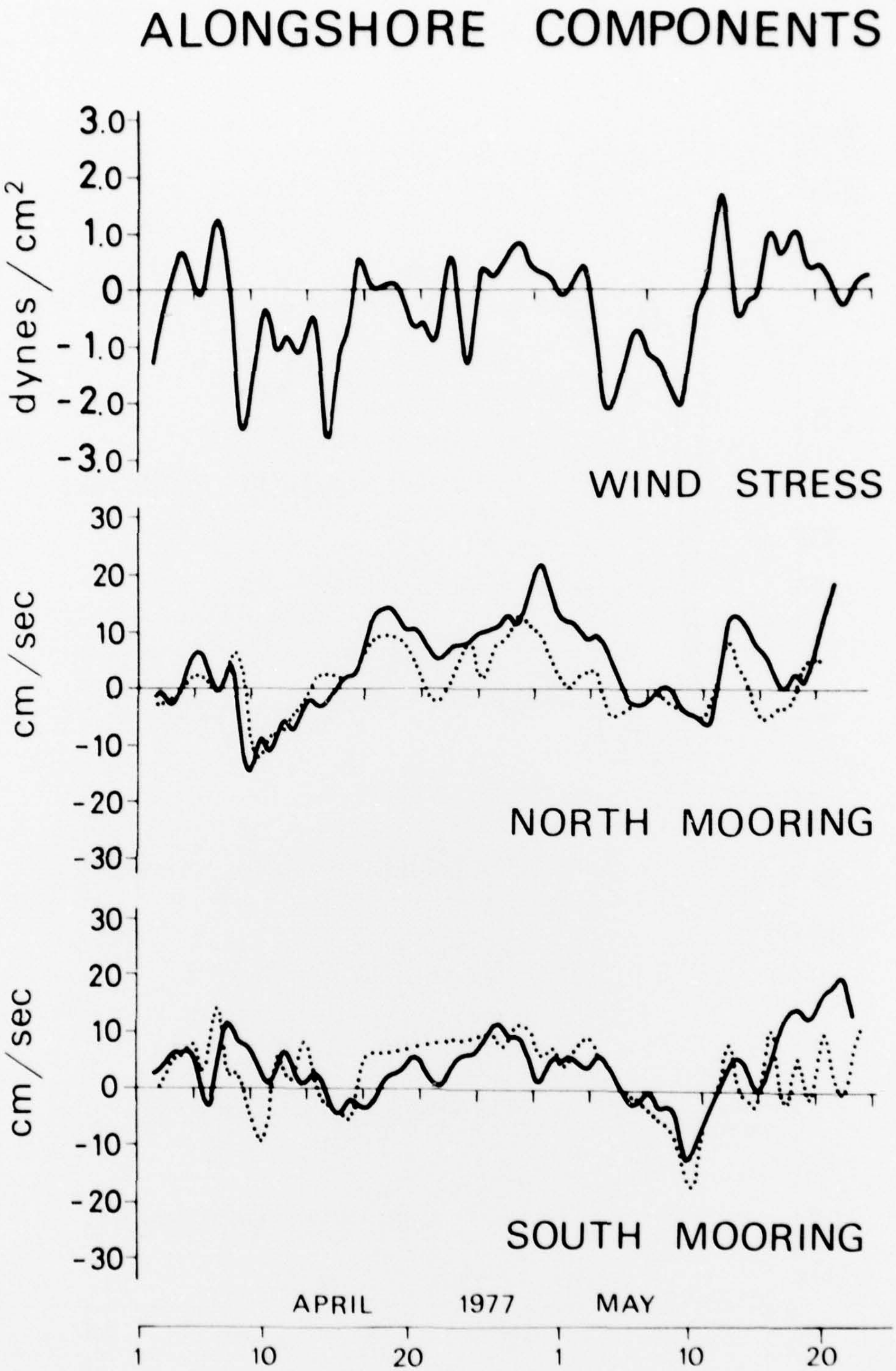


FIG. 8 TIME SERIES OF THE LOWPASS COMPONENTS OF WIND STRESS AND COASTAL CURRENTS. The currents at 20 m are shown by solid curves, those at 80 m are shown by dotted curves.

(a) ALONGSHORE COMPONENTS

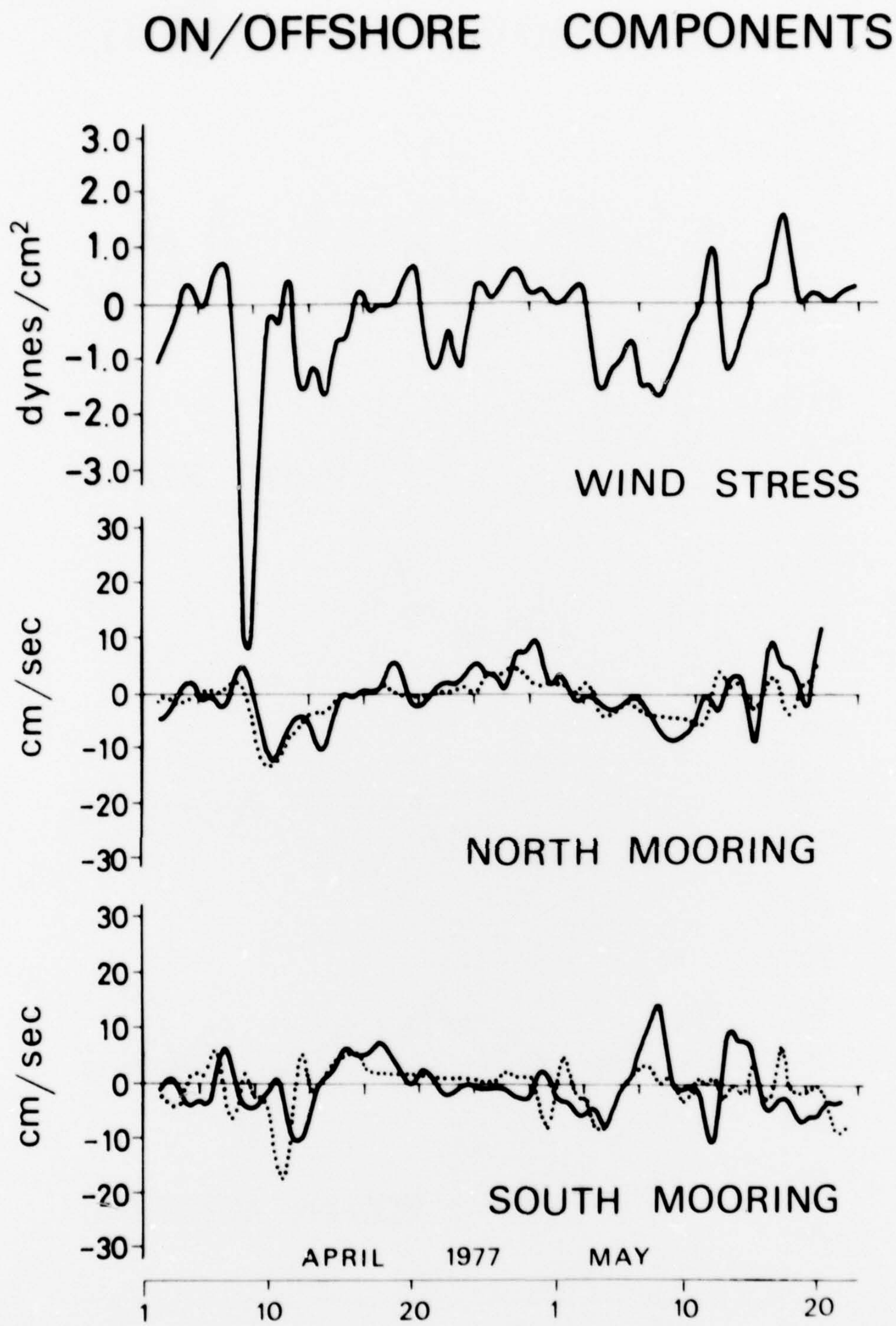


FIG. 8 TIME SERIES OF THE LOWPASS COMPONENTS OF WIND STRESS AND COASTAL CURRENTS. The currents at 20 m are shown by solid curves, those at 80 m are shown by dotted curves.

(b) ON/OFFSHORE COMPONENTS

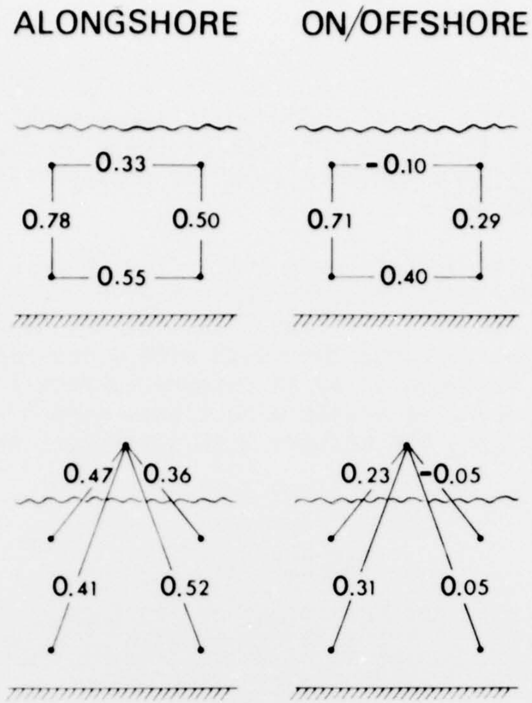


FIG. 9 THE CORRELATIONS BETWEEN THE CURRENT RECORDS, AND BETWEEN THE CURRENTS AND THE WIND (the 95% significance level is about 0.14).

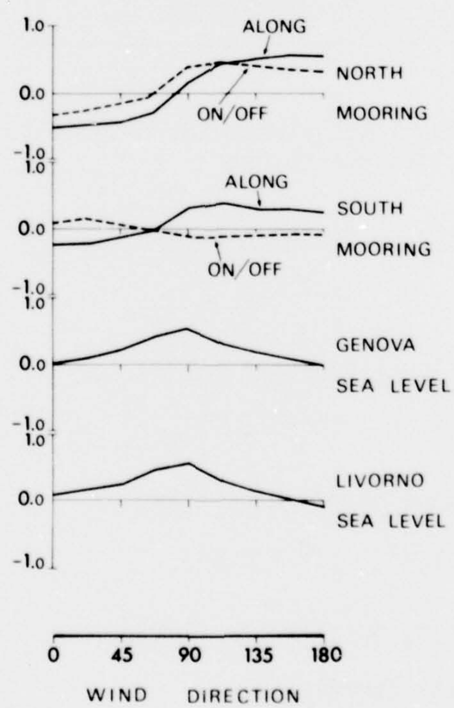


FIG. 10 THE CORRELATIONS BETWEEN THE COMPONENTS OF CURRENT AND SEA LEVEL AGAINST THE WIND, SHOWN AS A FUNCTION OF WIND DIRECTION.

correlation in the on/offshore direction was found to be insignificant. In other studies, Kundu et al *[6]* were able to explain 60 to 70% of the current variance along the coast of Oregon in terms of wind forcing, and Hunter et al *[9]* showed that more than 90% of the alongshore variance could be related to the wind during a study of coastal response near the mouth of the Chesapeake Bay.

However, estimates of the overall mean flows (i.e. when averaged over the total record length) were found to be in general agreement with each other, as is shown in Table 2. At both locations the near-surface flow was directed northwestwards along the coast with a mean speed of about 4.0 cm/s and this was accompanied by an onshore surface drift of about 0.5 cm/s. The mean components of the wind stress were directed down the coast at about 0.3 dyn/cm^2, and onshore with a strength of around 0.4 dyn/cm^2.

TABLE 2

THE MEANS AND STANDARD DEVIATIONS OF THE ALONGSHORE AND ON/OFFSHORE COMPONENTS OF THE NEAR-SURFACE (20 m) CURRENTS (cm/s) AND THE WIND STRESS (dyn/cm^2)

	Alongshore	On/offshore
North mooring	4.3 ± 7.6	-0.6 ± 4.8
South mooring	3.8 ± 6.2	-0.4 ± 4.8
Wind stress	-0.27 ±0.92	-0.42 ±1.19

The linear regression equations between the components of wind stress and surface flow were calculated to be:

The north mooring alongshore flow,

$$U = 1.85\tau + 4.88 \quad (r^2 = 0.22) \qquad \text{[Eq. 1]}$$

The south mooring alongshore flow,

$$U = 2.44\tau + 4.86 \quad (r^2 = 0.13) \qquad \text{[Eq. 2]}$$

The north mooring on/offshore flow,

$$U = 16.6\tau + 6.83 \quad (r^2 = 0.05) \qquad \text{[Eq. 3]}$$

The south mooring on/offshore flow,

no significant correlation

(For each of the above equations the value of r^2 is the percentage of the current fluctuations that can be explained in terms of a linear relationship with the wind.)

It is of interest to use Eqs. 1 and 2 to predict the strength of the surface flow for conditions of zero wind. Both equations give the same result, that of a flow directed up the coast at about 4.9 cm/s; this result is direct observational evidence of a density-driven flow moving up the west coast of Italy and suggests that a significant proportion of the flow continued northwards past the island of Elba.

From Eq. 1, for a typical wind stress of 0.5 dyn/cm^2 (corresponding to a wind speed of approximately 6 m/s) the surface flow would increase by about 1 cm/s or by about 0.2% of the wind speed. This is in conflict with the usual accepted ratio of about 3% *[4]* and suggests that the current fluctuations were not induced by wind-driving alone but were modified by other effects.

There are a number of reasons for the apparent poor correlation between the currents and wind: it is probable that the wind data used in the analysis, while being our best estimate of the overall wind, were not representative of the wind at the mooring positions. This can be resolved only be measuring the wind directly at sea and by further study into the variability of the coastal winds. The current response may also have been influenced by the local bottom topography. The data were collected in a shallow water area bordering the deep basins of the Ligurian and Tyrrhenian Seas; consequently the currents may have been influenced locally by the changes in bottom depth and orientation. In addition, some of the energy in the current fluctuations may have originated within the deep basins before travelling into the shallow coastal zone. Similarly, it is not known to what extent energy was trapped against the coast and how much energy was contained in free-travelling coastal waves. To answer such questions will require the collection of current data along additional sections of the coastal waters and the simultaneous monitoring of the currents within the deep basins.

REFERENCES

1. WUST, G. On the vertical circulation of the Mediterranean Sea. *Jnl Geophysical Research* 66, 1961: 3261-3271.

2. KRIVOSHEYA, V.G. and OVCHINNIKOV, I.M. Peculiarities in the geostrophic circulation of the waters of the Tyrrhenian Sea. *Oceanology* 13, 1973: 822-827.

3. SANKEY, T. The formation of deep water in the northwestern Mediterranean. *In:* WARREN, B.A., *ed.*, Progress in Oceanography Vol. 6. Oxford, Pergamon, 1973: pp. 159-179.

4. ROLL, H.U. Physics of the Marine Atmosphere. New York, Academic Press, 1965.

5. CANTU, V. The climate of Italy. *In:* WALLEN, C.C. *ed.* Climates of Central and Southern Europe, World Survey of Climatology Vol. 6. Amsterdam, Elsevier, 1977: pp. 127-183.

6. KUNDU, P.K., ALLEN, J.S., and SMITH, R.L. Modal decomposition of the velocity field near the Oregon coast. *Jnl Physical Oceanography* 5, 1975: 683-704.

7. ELLIOTT, A.J. Observations of the meteorologically-induced circulation in the Potomac estuary. *Estuarine & Coastal Marine Science* 6, 1978: 285-299.

8. WALLACE, J.M. and DICKINSON, R.E. Empirical orthogonal representation of time series in the frequency domain, Part I: Theoretical considerations. *Jnl Applied Meteorology* 11, 1972: 887-892.

9. HUNTER, J.R., BOICOURT, W.C., and HACKER, P.W. An analysis of the winter meteorological response at sub-tidal frequencies of the Atlantic continental shelf, Special Rpt 57. Baltimore, Md, Chesapeake Bay Institute, John Hopkins University, 1977.

APPENDIX

APPENDIX

HOURLY VALUES OF CURRENT AT THE NORTHERN MOORING

This appendix contains a listing of hourly values of the E-W and N-S components of the current measured at a depth of 80 m at the northern mooring. The first line of each listing is descriptive and gives the number of data points (1317), the start time in days (0.5, corresponding to 1200 hours local time on March 28, 1977) and the time interval between data points (0.041667 days, corresponding to 1 hour).

The format of the data cards are (I5,5X,10F7.2). The current components are in cm/s and are positive to the east and to the north.

ELBA 80M HOURLY VALUES OF EAST COMPONENT CM/S 1317 .500000 .041667

1	6.25	3.34	2.88	1.70	.96	-1.46	-3.47	-3.36	-5.00	-3.47
2	-1.31	-1.30	1.64	2.56	2.58	4.32	4.69	.16	-4.57	-6.57
3	-7.77	-8.93	-8.20	-8.26	-8.29	-10.53	-9.76	-13.02	-11.44	-9.98
4	-6.16	-2.44	-.74	2.67	4.77	4.23	1.25	1.57	.78	1.50
5	.96	2.34	3.67	3.78	7.39	12.06	12.30	10.82	12.36	9.31
6	8.03	6.55	6.58	5.24	4.65	6.16	6.98	11.23	12.44	12.79
7	12.58	12.50	11.40	7.37	5.76	4.77	4.43	6.21	.92	-.81
8	.45	2.45	4.29	6.92	6.95	6.17	6.44	8.85	7.97	9.31
9	9.51	9.05	9.72	6.48	6.36	5.02	5.74	5.80	7.71	8.97
10	9.35	8.47	6.79	4.05	1.86	1.44	1.88	3.15	4.15	4.50
11	5.72	4.94	4.66	5.29	4.89	4.92	5.15	5.49	4.39	7.34
12	5.68	4.72	4.43	4.84	4.95	5.81	3.28	1.26	3.35	4.70
13	6.37	5.20	4.57	5.71	4.75	3.99	4.50	3.92	3.31	1.95
14	1.03	-.33	.48	1.42	1.31	.96	1.98	2.98	3.98	4.97
15	6.21	3.77	2.08	.73	1.46	.15	-.86	-3.03	-4.32	-3.66
16	-1.79	-.03	-.49	.83	2.94	5.77	6.58	6.73	8.52	9.34
17	7.49	5.60	3.46	1.17	-.99	-2.12	-1.42	-3.40	-1.34	.20
18	2.44	5.37	6.78	7.42	7.69	6.64	5.37	3.76	-.50	-3.50
19	-3.60	-3.74	-2.49	-3.41	-3.77	-2.27	.60	4.15	7.20	6.31
20	4.45	2.63	1.68	1.57	1.34	1.31	1.58	1.78	1.95	-1.71
21	-3.25	-3.30	-3.69	-3.19	-1.33	-2.13	-3.00	-2.06	.22	1.44
22	3.78	4.83	2.93	1.80	-1.16	-2.57	-4.23	-4.94	-4.76	-3.74
23	-2.62	-.83	-.54	-.45	-.26	.65	.92	1.02	.50	.26
24	-.65	-1.44	.07	1.01	2.52	1.56	1.21	.20	-.21	.47
25	-.80	-1.26	.42	.00	-2.42	-4.25	-3.18	-1.01	-.07	-.63
26	.50	.85	.90	1.19	1.08	-2.03	-2.79	-1.26	-1.60	-4.09
27	-5.24	-6.31	-4.19	-4.67	-4.03	-.87	-1.58	-.45	-1.31	-2.36
28	-3.55	-3.37	-4.19	-6.72	-6.54	-6.09	-5.23	-7.73	-5.00	-2.82
29	.15	4.20	5.63	9.26	4.07	.92	3.48	7.38	.80	.75
30	-3.12	-5.80	-4.68	1.12	7.49	10.62	10.76	15.13	15.36	15.78
31	13.25	9.96	8.43	8.11	8.76	12.86	14.15	12.62	11.28	13.10
32	18.64	20.80	20.62	17.14	16.71	16.15	16.14	16.02	15.26	14.33
33	13.31	13.60	13.53	13.34	12.75	12.69	12.59	14.22	14.21	13.92
34	14.38	14.44	14.17	15.98	16.92	17.12	17.43	15.46	12.32	9.88
35	9.35	11.74	13.96	14.03	13.13	16.23	16.70	17.91	17.83	14.29
36	12.38	10.45	8.94	7.42	5.07	5.52	5.19	5.97	6.42	8.11
37	9.22	11.28	10.75	10.90	10.90	10.77	9.61	10.81	10.47	11.36
38	9.20	7.50	5.96	6.59	7.22	6.26	4.82	4.97	4.80	4.69
39	4.98	6.26	5.74	6.52	8.19	8.04	8.51	8.45	6.69	6.66
40	4.47	3.44	2.85	2.87	-2.76	.14	.45	-3.00	3.32	3.42
41	2.53	4.18	4.25	3.34	1.95	2.71	2.12	3.24	4.49	5.06
42	4.83	4.85	5.31	5.42	3.85	3.10	3.13	-2.17	-.51	2.17
43	2.79	1.95	-1.40	-.51	2.08	2.52	2.77	3.34	4.56	5.64
44	6.16	4.71	1.96	-1.42	-3.22	-3.05	-3.31	-2.03	-2.02	-1.07
45	-.63	-.42	.51	1.73	3.70	4.27	5.72	5.40	5.52	2.69
46	1.96	.99	-2.55	-2.62	-2.67	-2.73	-2.68	-3.46	-3.05	-.62
47	.01	1.25	2.20	2.85	2.65	2.72	1.71	.54	.13	.56
48	1.24	1.00	-1.45	-2.48	-2.06	-2.93	-1.72	-2.22	-2.66	-2.08
49	-1.64	-2.29	-1.56	-.22	-.19	-.21	-2.15	-3.62	-4.81	-4.63
50	-4.98	-5.70	-3.35	-2.36	-1.61	-1.53	-1.67	-1.62	-1.73	-1.79
51	-1.25	-1.38	-.20	-.67	-2.28	-3.33	-2.98	-2.42	-1.96	-3.04
52	-3.52	-3.98	-4.13	-4.44	-6.92	-7.13	-6.85	-4.44	-2.09	-1.92
53	-1.66	-1.00	-1.98	-1.44	-2.68	-2.73	-3.41	-4.21	-4.07	-6.43
54	-7.26	-6.12	-5.64	-3.57	-3.50	-6.56	-5.38	-1.12	.01	1.12
55	1.73	-.11	-1.83	-3.83	-3.44	-1.27	.12	-.50	-2.11	-3.02
56	-3.77	-4.46	-4.16	-3.98	-1.95	-.38	-.68	-.11	-.71	-1.06
57	-1.00	-1.23	-2.22	-2.91	-1.77	-2.37	-1.93	-2.16	-2.88	-2.66
58	-1.04	.23	.70	.66	.14	-.03	-1.04	-1.65	-.83	-.79
59	-2.80	-4.13	-5.02	-4.76	-3.14	-1.70	-1.71	-1.82	-1.33	-.25
60	-.18	1.23	3.41	3.61	2.66	2.47	1.35	.37	-.86	-1.37
61	-.35	-1.44	-1.56	.40	1.47	1.18	1.88	2.23	3.34	3.36
62	3.03	1.73	-.18	-.62	-.79	-2.05	-2.39	-2.02	-1.65	-1.35
63	.22	1.48	4.81	4.09	3.39	1.93	.81	-.09	-1.63	-3.03
64	-2.77	-2.93	-3.37	-3.83	-3.44	-2.15	-1.11	-.35	-.19	-.13
65	1.55	4.20	4.53	3.15	-1.02	.83	-1.29	-3.50	-4.21	-4.78
66	-4.96	-5.17	-2.38	-1.76	-2.06	-1.65	-.65	1.06	1.24	2.64
67	-3.24	-5.02	-4.30	-5.84	-7.73	-7.28	-7.18	-6.65	-5.47	-3.74
68	-1.76	-1.72	-1.63	-1.54	-1.45	-1.36	-1.27	-1.18	-1.09	-1.00
69	-.91	-.82	-.73	-.64	-.55	-.46	-.37	-.28	-.19	-.10

71	70	-.01	.33	.17	.26	.35	.44	-4.25	-5.64	-7.83	-9.30
72	71	-10.76	-11.13	-9.89	-9.95	-7.60	-7.79	-4.40	-2.42	-.04	-.05
73	72	-1.13	-2.94	-3.64	-5.01	-6.88	-7.50	-8.62	-8.97	-8.60	-9.37
74	73	-9.48	-6.73	-3.38	-2.03	-1.72	-1.18	-1.95	-2.94	-2.64	-4.91
75	74	-5.50	-7.00	-7.19	-7.07	-8.41	-8.14	-9.30	-9.59	-10.71	-10.61
76	75	-9.45	-6.07	-7.49	-2.25	-3.51	-4.46	-5.63	-8.22	-6.42	-7.00
77	76	-11.52	-14.09	-14.70	-12.25	-12.64	-12.64	-8.22	-4.10	-2.78	-3.20
78	77	-2.38	-2.91	-5.43	-7.97	-8.35	-6.23	-5.89	-4.66	-4.05	-5.90
79	78	-6.94	-7.38	-7.77	-7.06	-7.14	-7.14	-8.67	-8.98	-5.96	-5.65
80	79	-2.30	-1.34	-.29	-.81	-.65	-3.52	-4.68	-4.28	-3.01	-1.63
81	80	-3.05	-3.81	-3.80	-3.32	-1.57	-2.02	-2.82	-4.05	-4.11	-4.26
82	81	-6.10	-6.27	-4.92	-3.96	-3.70	-6.72	-7.55	-6.44	-4.05	-1.97
83	82	-.79	-1.10	-1.20	-.66	-1.53	-2.86	-4.05	-4.63	-4.50	-3.47
84	83	-3.85	-2.53	-1.00	-.01	.05	1.48	.74	-.79	-1.57	-.45
85	84	-1.27	-2.83	-4.72	-7.33	-6.72	-5.10	-2.23	-1.60	-.17	2.75
86	85	2.99	3.04	2.34	1.86	1.01	-.38	-1.39	-2.97	-3.85	-4.59
87	86	-3.67	-2.84	-1.14	1.25	.60	.69	1.20	2.47	3.31	2.70
88	87	2.06	-.42	-2.21	-3.57	-3.75	-3.99	-3.70	-2.44	-2.71	-4.03
89	88	-3.02	-2.76	-1.81	-1.59	-2.59	-2.81	-2.96	-.73	-.89	-1.24
90	89	-2.16	-5.02	-4.43	-3.64	-3.29	-4.07	-4.70	-3.89	-1.59	-.91
91	90	-.17	-.13	2.28	6.45	8.23	7.22	5.61	4.09	2.89	2.15
92	91	2.97	1.10	3.81	5.70	6.10	7.16	7.67	7.31	5.31	2.93
93	92	3.19	2.40	4.10	4.70	3.99	4.73	5.61	6.56	8.07	9.00
94	93	5.52	3.35	1.31	1.42	-.38	-.03	2.82	4.80	5.76	6.05
95	94	5.50	5.88	5.33	4.26	3.04	2.69	2.04	1.41	2.17	3.61
96	95	4.57	5.17	4.04	3.22	1.97	1.68	1.51	1.23	.93	1.25
97	96	2.10	1.51	1.85	2.16	1.62	2.24	3.49	4.34	4.53	1.70
98	97	1.02	1.46	4.23	4.23	5.02	4.63	6.83	7.62	7.04	7.93
99	98	4.36	3.61	1.22	.81	.93	.79	2.81	2.50	2.16	4.51
100	99	4.95	7.35	6.34	3.46	2.75	1.47	1.39	1.63	2.55	3.74
101	100	5.07	4.90	4.63	4.50	4.09	4.89	4.65	6.69	6.30	6.28
102	101	6.92	6.91	4.52	3.44	4.51	3.77	2.59	2.72	1.93	1.51
103	102	2.47	3.82	4.88	6.70	7.93	7.00	5.18	4.28	3.65	3.85
104	103	4.45	5.56	6.25	7.01	6.84	6.65	5.15	2.99	3.18	3.01
105	104	3.10	3.79	5.20	5.63	6.50	5.80	4.47	5.22	5.39	6.25
106	105	6.05	5.65	6.55	6.48	6.20	4.78	5.02	4.61	5.39	5.33
107	106	3.32	3.77	3.87	3.65	4.03	5.81	5.83	7.10	6.42	6.61
108	107	6.85	6.78	8.08	7.84	5.50	7.82	8.41	8.67	8.11	6.64
109	108	7.43	6.54	5.12	4.61	4.21	3.37	4.78	6.25	7.01	6.64
110	109	5.54	5.59	5.70	5.39	4.39	3.77	3.86	3.65	3.62	3.03
111	110	2.44	2.41	2.74	2.73	2.44	1.88	1.95	.03	-3.30	-4.51
112	111	-6.06	-8.25	-9.54	-9.76	-10.01	-10.31	-10.00	-11.91	-10.99	-8.77
113	112	-8.53	-8.64	-5.99	-3.76	-1.06	-.59	1.14	2.53	.83	-.24
114	113	-1.25	-2.63	-3.02	-5.99	-6.46	-6.42	-4.98	-4.04	-4.58	-1.75
115	114	.63	2.28	2.51	3.06	4.89	3.42	1.95	-2.54	-6.06	-7.27
116	115	-7.35	-6.56	-6.33	-5.97	-5.16	-.52	1.92	2.14	1.02	.52
117	116	-2.65	-3.20	-3.55	-5.05	-3.05	-.06	-1.19	1.37	3.03	3.35
118	117	4.91	3.86	2.82	4.21	4.60	5.25	5.12	4.87	5.25	6.78
119	118	7.17	9.90	10.64	5.77	4.07	5.06	4.73	3.62	.16	-2.85
120	119	-1.53	.99	.32	-1.22	-1.12	-1.96	-1.42	-2.34	-2.66	-.86
121	120	.17	-1.51	2.22	.51	-.59	-1.55	-.73	.57	.04	-.37
122	121	-.51	-2.30	-2.46	-2.97	-5.14	-4.87	-2.00	-2.51	-2.49	-1.70
123	122	-.81	-.84	-1.61	.59	1.91	1.30	2.01	1.74	-.37	-.42
124	123	1.72	1.13	2.49	4.06	6.61	6.26	4.23	4.07	4.43	4.77
125	124	3.29	3.17	3.49	6.05	2.94	1.49	1.72	-.68	-1.03	-1.25
126	125	-.23	-.44	-.07	-.01	.20	-.29	-1.50	-5.31	-5.94	-4.90
127	126	-5.36	-.89	-.73	-.16	-1.43	-2.34	-4.63	-5.57	-6.91	-7.11
128	127	-6.55	-3.87	-3.41	-1.79	-.51	.03	.24	.08	-.23	-.99
129	128	-2.71	-4.82	-5.22	-2.32	-2.21	-2.73	-3.63	-4.42	-5.84	-4.51
130	129	-2.79	-.10	-.18	.10	-1.53	-2.71	-5.46	-6.18	-5.99	-3.85
131	130	-5.89	-5.06	-3.61	-2.29	-1.82	-2.36	-2.09	-1.97	-3.85	-3.98
132	131	-6.41	-5.86	-3.08	-.10	-.59	1.15	.12	-1.02	-1.02	-1.08
133	132	-.46	-2.57	-2.59	-2.82	-4.75	-4.74	-4.49	.00	.00	.00

ELBA 80M HOURLY VALUES OF NORTH COMPONENT CM/S 1317 .500000 .041667

1	-4.48	-5.02	-2.80	-3.39	-4.38	-3.28	-2.17	.52	2.24	3.16
2	3.23	3.62	2.71	2.06	.81	-.46	-5.01	-6.04	-4.24	-.65
3	2.91	1.59	1.79	2.06	.53	-2.24	-2.50	.54	7.01	10.66
4	14.14	12.62	12.00	10.18	5.35	3.99	5.83	6.47	7.94	9.69
5	9.48	8.93	7.17	5.25	4.70	2.44	1.41	.92	1.12	3.02
6	4.41	4.96	5.91	6.55	6.94	7.49	8.61	6.40	4.71	4.68
7	4.77	.19	-.80	-.67	.23	1.20	2.22	.68	2.78	7.58
8	7.59	7.11	5.27	1.32	.41	.96	-1.42	-1.97	-1.99	-1.66
9	-2.84	-4.59	-5.36	-6.34	-5.54	-4.67	-4.14	-3.12	-6.52	-6.44
10	-6.11	-5.18	-4.21	-4.14	-4.98	-5.01	-3.74	-2.86	-3.09	-2.84
11	-4.06	-4.43	-3.29	-2.70	-3.63	-5.20	-4.61	-4.35	-5.43	-6.39
12	-7.26	-7.93	-6.45	-5.98	-5.74	-4.92	-3.06	-.91	-.59	-.27
13	-2.86	-3.67	-3.78	-4.99	-4.56	-5.00	-4.66	-4.86	-5.47	-4.55
14	-3.57	-1.89	-.63	.39	-.60	-1.71	-1.94	-1.96	-2.44	-2.80
15	-4.29	-5.97	-5.96	-6.35	-7.89	-7.59	-8.50	-7.83	-6.10	-4.36
16	-.43	1.78	2.42	3.53	4.80	3.72	1.96	-.05	-2.49	-5.03
17	-6.09	-7.95	-8.31	-6.36	-5.95	-3.31	-1.23	2.01	3.95	5.84
18	5.39	1.56	.19	.82	-1.94	-3.26	-3.74	-4.27	-4.17	-3.78
19	-2.25	.27	.63	1.24	1.38	2.00	4.65	4.57	2.97	.26
20	1.27	1.57	.60	.08	.77	1.12	1.00	.78	.05	.03
21	1.26	1.90	4.26	4.79	4.44	4.93	5.04	4.23	4.60	3.28
22	.22	-1.25	-3.23	-2.28	-2.39	-1.06	.92	2.00	2.54	4.09
23	3.44	3.44	1.85	1.80	2.00	2.17	1.43	.99	1.41	1.46
24	1.30	.06	-2.54	-3.40	-4.42	-4.11	-2.69	-2.44	-1.88	-1.37
25	-1.56	-1.39	1.13	1.75	1.59	2.77	3.42	3.61	2.26	3.26
26	2.34	1.24	3.56	1.82	1.32	3.49	3.02	2.57	2.05	1.85
27	2.95	2.51	2.60	3.02	5.04	5.79	5.63	3.61	3.27	2.90
28	1.47	3.70	5.01	5.26	6.73	7.20	9.36	9.65	12.06	11.93
29	11.99	10.80	8.92	2.30	-9.68	-10.27	-9.56	-6.99	-10.32	-8.74
30	-6.38	-.84	4.14	8.18	1.39	.62	-.11	-8.16	-11.29	-14.21
31	-14.41	-13.87	-11.94	-13.75	-13.36	-10.05	-5.23	-5.55	-.48	-5.45
32	-12.80	-13.72	-13.33	-13.86	-10.72	-7.65	-5.56	-10.10	-9.49	-8.17
33	-6.36	-5.02	-5.87	-3.56	-2.44	-.15	-.44	-.18	-.02	-.87
34	-3.68	-6.18	-8.65	-7.32	-7.68	-9.89	-9.20	-8.58	-7.11	-5.14
35	-2.73	-.20	-.41	-1.85	-.14	-2.30	-1.69	-4.71	-5.41	-7.40
36	-7.07	-8.54	-8.49	-8.16	-8.82	-6.81	-5.75	-3.51	-2.18	-2.75
37	-2.07	-2.37	-2.33	-1.48	-.58	-1.57	-1.09	-1.40	-2.15	-3.80
38	-4.98	-4.83	-5.16	-3.15	-3.36	-3.76	-1.28	-.24	1.08	2.19
39	2.28	2.62	1.18	.60	-2.11	-3.52	-3.97	-4.43	-4.22	-3.02
40	-1.76	-.99	-.35	-.93	-3.11	-4.21	-4.97	-1.93	1.38	1.31
41	3.47	3.96	4.32	5.65	6.10	6.95	5.89	8.39	7.06	5.12
42	2.93	.95	.84	-.57	-1.60	.05	2.26	2.86	3.52	3.03
43	3.09	2.90	3.71	4.53	4.87	5.93	6.52	6.25	5.17	3.42
44	1.63	-2.36	-5.71	-5.65	-3.28	-1.94	.73	3.32	4.08	5.44
45	7.91	8.62	8.44	7.27	6.30	4.92	3.11	1.27	1.85	-3.09
46	-3.89	-4.53	-1.17	-.36	-1.00	-1.03	-.98	-.09	1.38	3.66
47	3.93	4.02	2.89	3.47	3.14	2.86	2.02	2.46	1.72	1.41
48	.48	.06	-.98	.56	2.93	2.97	4.01	5.07	5.38	5.72
49	5.39	6.52	6.39	6.20	4.29	3.15	1.95	1.76	3.35	4.41
50	5.68	7.05	7.57	6.45	5.32	4.78	5.31	4.83	5.03	5.94
51	6.59	9.55	10.69	10.98	10.27	8.58	7.93	7.47	6.58	7.07
52	7.87	7.73	7.91	8.18	8.62	10.03	10.02	10.23	9.25	9.81
53	9.13	9.21	8.52	6.60	5.28	7.25	9.98	11.24	10.88	9.75
54	10.41	8.17	6.40	5.14	5.73	7.83	7.39	7.69	8.05	9.48
55	10.32	8.14	7.41	7.79	9.29	10.11	9.46	8.22	7.43	7.42
56	8.18	11.05	11.50	12.18	10.43	9.22	7.67	7.32	6.54	5.84
57	5.15	4.74	4.66	6.10	7.85	7.49	6.74	6.26	5.95	4.95
58	5.96	5.09	3.81	4.67	5.48	5.41	5.29	5.45	4.78	3.35
59	2.42	2.98	3.98	5.28	4.96	4.63	4.22	4.18	4.68	5.01
60	3.63	2.87	1.22	-.74	-2.07	-5.79	-5.62	-5.52	-4.95	-3.53
61	-2.37	-1.28	2.96	2.88	1.90	.93	1.39	.61	-.79	-2.48
62	-2.53	-3.27	-3.54	-3.51	-3.62	-3.45	-2.80	-1.33	-.24	.50
63	1.85	1.53	-.69	-3.10	-4.19	-5.12	-5.06	-3.90	-3.93	-2.61
64	-1.72	-1.01	.01	1.66	4.21	6.73	7.93	8.16	8.00	6.82
65	5.41	3.76	.81	-1.69	-3.38	-4.28	-3.40	-1.47	1.67	4.15
66	6.46	8.34	10.09	9.91	8.47	7.82	8.86	9.30	8.95	2.85
67	4.07	2.44	3.81	4.23	5.27	4.32	5.41	6.07	6.65	8.72
68	9.93	11.15	10.54	9.94	9.33	8.73	8.12	7.51	6.91	6.30
69	5.69	5.09	4.48	3.88	3.27	2.66	2.06	1.45	.84	.24

71	70	-.37	-.97	-1.58	-2.19	-2.79	-3.40	-2.95	-3.63	-2.20	.25
72	71	1.86	4.20	6.32	10.88	12.90	13.43	12.04	11.66	10.45	5.40
73	72	4.79	4.13	3.23	3.17	4.24	5.26	6.07	6.84	6.36	6.46
74	73	7.36	8.81	8.17	6.30	6.32	6.99	6.49	5.25	5.56	6.20
75	74	5.31	6.49	7.28	7.62	9.04	8.17	7.80	9.09	10.12	12.43
76	75	13.15	14.02	12.68	9.11	7.34	5.60	6.06	7.18	9.06	7.04
77	76	10.55	13.46	13.53	13.87	14.76	16.24	15.83	15.68	14.64	11.80
78	77	12.03	11.56	9.33	8.23	8.57	9.36	8.92	7.60	6.35	6.22
79	78	7.84	10.49	10.88	11.98	10.97	11.35	12.13	12.52	11.86	9.15
80	79	9.79	9.25	8.33	7.77	8.82	7.43	7.04	6.92	8.25	9.17
81	80	8.39	9.73	9.01	9.16	9.55	10.08	8.27	6.71	7.23	7.75
82	81	7.51	8.10	8.05	7.63	6.81	5.50	5.44	5.38	5.57	5.36
83	82	4.73	3.75	3.92	3.70	3.37	3.12	2.06	1.23	1.36	2.03
84	83	2.55	3.62	4.76	4.14	3.71	5.90	5.27	3.82	3.14	-1.56
85	84	-5.64	-6.23	-5.36	-3.45	-.94	-1.27	-.70	-.17	1.87	2.14
86	85	1.78	.04	-.63	-3.46	-3.01	-2.55	-1.08	.89	2.68	3.97
87	86	6.84	7.39	7.24	5.40	4.50	3.80	3.31	1.75	.84	-.20
88	87	-2.16	-2.02	-.32	1.04	1.67	1.67	1.35	1.37	2.31	3.82
89	88	5.37	5.43	2.35	1.85	3.08	3.79	3.24	1.40	1.19	.93
90	89	.65	.27	.68	.85	1.86	3.32	4.90	6.50	6.67	6.55
91	90	5.70	4.72	4.26	4.32	1.16	-.45	-2.91	-4.25	-3.17	-3.51
92	91	-3.60	-3.93	-3.72	-1.47	-1.15	-1.78	-3.30	-5.13	-5.86	-5.35
93	92	-3.98	-3.17	-.31	-1.27	-1.44	-2.91	-3.82	-3.98	-4.23	-5.32
94	93	-5.99	-6.41	-5.56	-3.92	-2.97	-2.10	-.37	.53	-1.68	-3.47
95	94	-4.96	-4.52	-4.30	-4.88	-4.75	-3.80	-2.23	.12	.88	1.00
96	95	-.06	-1.54	-3.79	-3.65	-3.67	-3.91	-3.48	-2.08	-1.45	-1.69
97	96	-1.97	-1.89	-2.30	-3.38	-3.09	-3.06	-2.90	-3.22	-3.06	-1.61
98	97	-1.29	-1.23	-.16	1.25	-.55	-2.27	-3.73	-3.13	-4.32	-5.38
99	98	-5.39	-5.26	-3.07	-1.72	3.51	4.24	.52	-.79	-1.26	-.66
100	99	.15	-.94	-1.41	-2.55	-1.42	-.29	1.40	3.63	3.94	2.40
101	100	1.65	1.41	-.10	-.49	-1.05	-.46	1.10	2.06	2.26	2.12
102	101	-.15	-2.60	-4.12	-3.95	-3.97	-3.76	-4.39	-5.02	-4.21	-2.51
103	102	2.60	4.25	4.13	3.13	1.10	-.42	-2.61	-3.42	-4.56	-3.67
104	103	-3.86	-3.60	-3.16	-2.59	-3.35	-4.04	-4.02	-3.93	-3.73	-2.15
105	104	-.63	.19	.75	.26	-.79	-1.31	-.12	.56	.05	-1.36
106	105	-1.83	-1.96	-2.71	-3.83	-4.29	-3.79	-4.10	-3.36	-3.73	-4.32
107	106	-5.22	-4.26	-3.54	-3.88	-2.81	-2.05	-2.66	-3.00	-3.35	-3.49
108	107	-3.36	-2.96	-3.02	-3.57	-3.54	-3.99	-4.35	-5.00	-5.47	-4.20
109	108	-4.07	-3.47	-3.17	-2.52	-1.94	-.85	-.33	-.16	.33	.93
110	109	.51	.73	.45	.42	.44	1.11	2.80	3.68	4.12	3.81
111	110	4.22	3.83	3.75	3.16	3.20	3.87	4.27	4.51	2.62	2.00
112	111	1.20	.87	.18	-.20	.58	2.52	5.11	6.67	10.29	12.90
113	112	14.95	16.79	19.76	18.56	16.10	10.86	6.00	1.43	-3.35	-4.24
114	113	-4.48	-3.72	-3.83	-.87	1.45	2.78	3.57	6.36	7.55	9.30
115	114	8.29	7.72	7.12	4.58	.56	-2.11	-5.16	-4.51	-2.47	-.77
116	115	.51	1.33	.83	1.17	3.21	5.70	4.47	2.09	-.85	-4.31
117	116	-5.28	-3.75	-4.77	-3.92	-2.40	-3.11	-3.13	-3.64	-2.52	.00
118	117	-1.34	-3.04	-3.33	-4.39	-5.35	-6.32	-8.38	-8.38	-6.93	-4.63
119	118	-5.44	-6.48	-7.02	-4.10	-1.98	-.58	-1.27	-1.33	-2.79	-2.09
120	119	-.78	-2.12	-4.68	-5.18	-4.66	-4.70	-4.88	-4.76	-4.59	-5.18
121	120	-6.08	-5.32	-4.96	-5.90	-6.90	-5.48	-4.64	-3.04	-2.73	-1.98
122	121	-2.42	-3.58	-4.68	-4.26	-1.57	-2.56	-2.24	-5.13	-5.54	-4.99
123	122	-4.86	-4.39	-3.55	-4.08	-7.21	-6.27	-5.81	-5.87	-6.75	-3.29
124	123	-2.00	-1.79	.53	2.61	4.73	3.77	2.45	1.66	1.34	2.36
125	124	3.55	5.73	4.09	2.80	3.71	6.09	4.89	5.46	5.66	6.87
126	125	5.91	5.69	5.86	5.46	4.25	3.42	3.29	5.24	6.96	4.33
127	126	3.20	5.15	3.83	3.72	2.82	.23	-1.16	.19	4.35	4.66
128	127	5.73	6.63	6.93	7.32	3.96	4.03	3.33	3.57	3.16	1.84
129	128	1.90	3.32	5.14	8.15	6.88	4.44	3.62	5.23	7.80	7.79
130	129	7.28	6.53	4.86	4.33	2.84	4.61	4.11	3.58	4.17	2.67
131	130	3.91	3.53	5.15	5.79	4.31	3.11	2.95	2.94	2.38	1.73
132	131	1.75	4.48	4.72	5.85	6.46	7.51	6.78	6.31	4.52	4.68
133	132	5.14	5.34	5.51	5.55	4.43	3.86	5.05	.00	.00	.00